REMARKS/ARGUMENTS

This is a Response to the Office Action mailed March 11, 2004, in which a three (3) month Shortened Statutory Period for Response has been set, due to expire June 11, 2004. Thirty-three (33) claims, including seven (7) independent claims, were paid for in the application. Claims 1, 3, 8-9, 11, 19, 21-22 and 26-28 have been canceled. Claims 2, 4-7, 10, 12-13, 20, 23-25 and 29 have been amended. As currently amended, there are twenty-two (22) claims, including nine (9) independent claims. A fee of $172 is enclosed for the additional independent claims. The Director is authorized to charge any additional fees due by way of this Amendment, or credit any overpayment, to our Deposit Account No. 19-1090. Upon receipt of this amendment, claims 2, 4-7, 10, 12-18, 20, 23-25 and 29-33 will be pending.

Objections

Claim 29 has been amended above as suggested by the Examiner.

Claims 13, 15-16, 18, 20, 23 and 31-32 were objected to as being dependent on a rejected base claim. Claims 13, 20 and 23 have been rewritten in independent form to include all limitations of the base claims and any intervening claims, and are thus allowable. Claims 24-25 have been amended to be dependant on claim 23, and are thus allowable. It is noted that in rewriting the claims in independent form, the scope of the claims has not changed and the amendment should not be considered as narrowing the scope of claims 13, 20 and 23.

35 U.S.C. §102(b) Rejections

Claims 1-6, 8-10, 14, 17, 19, 21-22, 24 and 26-28 were rejected under 35 U.S.C. §102(b) as being anticipated by Fuglevand et al. (U.S. Patent No. 6,387,556) (hereinafter Fuglevand).

Fuglevand is generally directed to a fuel cell system. The fuel cell system taught by Fuglevand comprises one or more fuel cell cartridges 14, control system 30, power supply 32, charge circuit 34, and switching device 38. *Fuglevand*, Figure 2. Each of the fuel cell cartridges 14 includes a plurality of individual fuel cells, *Fuglevand*, col. 3, lines 59-65, so may be referred to as a fuel cell stack. The switching device 38 is operable to selectively couple the fuel cell

cartridges 14 to, and from, the power bus 60 to supply power from the fuel cell stack 14 to an external load 62. *Fuglevand*, col. 7, lines 32-56.

Fuglevand also teaches that during start-up, the control system 30 receives power from batteries which are part of the power supplies 32. *Fuglevand*, col. 7, lines 57-58. After startup, the power supplies 32 are coupled to the power bus 60 to receive power from the fuel cell cartridges 14. *Fuglevand*, col. 7, lines 58-62. No specific circuit or switch is disclosed to couple the batteries of the power supplies 32 to the power bus 60. In fact, it is not clear whether the batteries are ever uncoupled from the power supplies 32. For example, the batteries may be permanently electrically coupled in parallel with the fuel cell cartridges 14. Because fuel cell stacks are typically too slow to react to changes in demand, some fuel cell systems couple batteries in parallel with the fuel cell stack across the output bus for absorbing and supplying power as required, to temporarily accommodate such changes in the load until the fuel cell stack adjusts.

Fuglevand further teaches that after start-up, the charge circuit 34 selectively charges the batteries from the power supplied by the fuel cell stack 14 via the power bus 60. *Fuglevand*, col. 7, lines 62-64. The charge circuit 34 may rely on battery conditions and the output of the power supply 32 when selectively charging the battery. *Fuglevand*, col. 7, line 64-col. 8, line 2. Importantly, these conditions are unrelated to whether the power will be supplied to the control system 30 from the fuel cell cartridges 14 or the battery, which appears to be based only on the specific operating mode (i.e., start-up mode or running mode).

Additionally, Fuglevand teaches the use of switching devices 96, operable to shunt (*i.e.*, short circuit to electrically bypass) fuel cells, for example, 1) when such fuel cells are performing poorly; 2) to generate excess heat during start-up; or 3) to maintain electrical continuity of the power bus 60 upon physical removal of a fuel cell. *Fuglevand*, col. 10, lines 11-21, col. 9, lines 14-26. Importantly, the switching devices 96 are merely to shunt individual fuel cells 14 rather than selectively electrically coupling the control system 30 between the fuel cell stack and the battery. Note that unlike switch 38, the switching devices 96 are electrically coupled across the individual contacts 84 of the fuel cell cartridges 14, rather than in series with fuel cells and the power bus 60.

Turning to the specific claim language, claim 4 recites, *inter alia*, "a power supply switch is responsive to the fuel cell stack voltage to couple power from the fuel cell stack to the fuel cell control system at a first time while the voltage across the fuel cell sack is above a fuel cell stack threshold voltage and to couple power from the battery to the fuel cell control system at a second time while the voltage across the fuel ell stack is below the fuel cell stack threshold voltage."

Importantly, while Fuglevand teaches that the fuel cell stack voltage (*i.e.*, voltage across power bus) may be monitored along with other conditions *to selectively control the charging of the batteries*, (Fuglevand, col. 7, line 65-col. 8 line 2), it fails to teach or suggest that such monitored conditions may be utilized in deciding whether to couple the fuel cell cartridge or stack 14 to the power bus 60 and hence to the power supplies 32. As noted above, it appears that Fuglevand only teaches the automatic coupling of the fuel cell cartridges 14 to the power bus 60 in *response to the end of the start-up condition*, simply assuming or not caring whether the fuel cell cartridges 14 are producing sufficient voltage to support the load(s) on the power bus 60. Since switch 38 is responsive to the operating mode (start-up condition) rather than the actual voltage output of the fuel cell cartridge or stack, Fuglevand would couple the fuel cell stack to the power bus, and hence to the power supplies and control system, even if the fuel cell stack was not producing sufficient current for the load(s), for example, during an anomaly in operation of the fuel cell stack. Thus, Fuglevand does not teach or suggest "a power supply switch is responsive to the fuel cell stack voltage to couple power from the fuel cell stack to the fuel cell control system at a first time while the voltage across the fuel cell sack is above a fuel cell stack threshold voltage and to couple power from the battery to the fuel cell control system at a second time while the voltage across the fuel cell stack is below the fuel cell stack threshold voltage" as recited by claim 4.

While claim 4 has been rewritten in independent form, such rewriting has not narrowed the scope of the claim, and claim 4 was thus allowable as originally filed.

Claim 5 recites, *inter alia*, "a power supply switch responsive to a voltage across the fuel cell stack to couple power from the fuel cell stack to the fuel cell control system at a first time when the voltage across the fuel cell stack rises above a first fuel cell stack threshold

voltage and to couple power from the battery to the fuel cell control system at a second time when the voltage across the fuel cell stack falls below a second fuel cell stack threshold voltage."

As discussed above, Fuglevand teaches monitoring the fuel cell stack voltage along with other conditions *to selectively control the charging of the batteries*, but fails to teach or suggest that such monitoring may be utilized in deciding whether to couple the fuel cell stack 14 or battery to the power bus 60, and hence to the power supplies 32 and control system 30. Additionally, Fuglevand fails to teach or suggest the use of two voltage thresholds, a first voltage threshold for determining when to couple power from the fuel cell stack to the fuel cell control system and a second voltage threshold for determining when to couple power from the battery to the fuel cell control system. Thus, Fuglevand cannot be said to teach "a power supply switch responsive to a voltage across the fuel cell stack to couple power from the fuel cell stack to the fuel cell control system at a first time when the voltage across the fuel cell stack rises above a first fuel cell stack threshold voltage and to couple power from the battery to the fuel cell control system at a second time when the voltage across the fuel cell stack falls below a second fuel cell stack threshold voltage" as recited by claim 5.

The rewriting of claim 5 has not narrowed the scope of the claim, and thus claim 5 was allowable as originally filed.

Claim 6 is dependent from claim 4 and further recites "wherein the power supply switch is further responsive to an operating state of the fuel cell system." Fuglevand does not teach a switch that is responsive to both a voltage and an operating mode.

Claim 10 is dependent from rewritten claim 12 and further recites "the battery supply switch is responsive to the voltage across the fuel cell stack in a number of the operating states of the fuel cell system." Fuglevand does not teach a switch which is responsive to both a voltage and an operating mode.

Claim 14 recites, *inter alia*, "a power supply switch configured to selectively switch power from the fuel cell stack to at least one of the microcontroller, the sensor and the actuator when a voltage across the fuel cell stack is above a first fuel cell stack threshold voltage and to selectively switch power from a battery to at least one of the microcontroller, the sensor

and the actuator when the voltage across the fuel cell stack is below a second fuel cell stack threshold voltage."

As discussed above, Fuglevand teaches monitoring the fuel cell stack voltage along with other conditions *to selectively control the charging of the batteries*, but fails to teach or suggest employing the fuel cell stack voltage in deciding whether to couple the fuel cell stack 14 or battery to the power bus 60, and hence to the power supplies 32 and control system 30. Also as discussed above, Fuglevand fails to teach or suggest the use of two voltage thresholds, a first voltage threshold for determining when to couple power from the fuel cell stack to the fuel cell control system and a second voltage threshold for determining when to couple power from the battery to the fuel cell control system. Thus, Fuglevand does not teach "a power supply switch configured to selectively switch power from the fuel cell stack to at least one of the microcontroller, the sensor and the actuator when a voltage across the fuel cell stack is above a first fuel cell stack threshold voltage and to selectively switch power from a battery to at least one of the microcontroller, the sensor and the actuator when the voltage across the fuel cell stack is below a second fuel cell stack threshold voltage" as recited in claim 14.

Claim 17 recites, *inter alia*, "a power supply switch configured to selectively switch power from the fuel cell stack to the microcontroller in a first operating state when a voltage across the fuel cell stack is above a first fuel cell stack threshold voltage and to selectively switch power from a battery to the microcontroller in the first operating state when the voltage across the fuel cell stack is below a second fuel cell stack voltage."

As discussed above, Fuglevand teaches that the source of power to the control system is dependent on operating state (start-up condition, or not), and independent of actual voltage produced. Fuglevand does not address switching the power source for the control system within an operating state (*e.g.*, switching between battery and fuel cell while starting up, or switching between battery and fuel cell while running or operating). Further as discussed above, Fuglevand does not teach or suggest the use of two voltage thresholds. Thus, Fuglevand does not teach "a power supply switch configured to selectively switch power from the fuel cell stack to the microcontroller in a first operating state when a voltage across the fuel cell stack is above a first fuel cell stack threshold voltage and to selectively switch power from a battery to the

microcontroller in the first operating state when the voltage across the fuel cell stack is below a second fuel cell stack voltage" as recited by claim 17.

Claim 24 is dependent on claim 23, which was rewritten in independent form in response to the Examiner's indication that such claim would be allowable. Claim 24 recites "wherein the first time corresponds to a time when the fuel cell system is in a first operating state and the second time corresponds to a time when the fuel cell system is in a second operating state." In Fuglevand, the switching always occurs on transition between operating states or modes; there is no suggestion that switching may in a single mode based, for example, on a change in voltage.

Rejections Under 35 U.S.C. § 103

Claims 7, 11, 12, 25, 29, 30 and 33 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Fuglevand et al. (U.S. Patent No. 6,387,556).

As discussed above, Fuglevand discloses a fuel cell system which provides power to a control system from a battery during start-up, and couples the fuel cell stack to the power bus after start-up to provide power to an external load and internal loads including the control system.

The Examiner rejects claim 12 stating that Fuglevand "teaches voltage responsive switching devices (MOSFETs 96) having outputs coupled to the microcontroller", and relying on Figure 4 of Fuglevand. The applicant respectfully notes that the MOSFETs 96 have their control inputs (gate electrodes) coupled to an output of the control system, by which the control system is able shunt or bypass the respective fuel cell. *Fuglevand*, col. 10, lines 9-10; col. 10, lines 14-15; Figure 4. Thus, the MOSFETs 96 are not capable of coupling power to any load, much less to the power input of the internal power supply 32. Consequently, Fuglevand does not teach or suggest "a power switching circuit configured to selectively couple power from the fuel cell stack to the microcontroller at a first time, and to selectively couple power from a battery to the microcontroller at a second time wherein the power switching circuit comprises a voltage responsive switching circuit having an output coupled to the microcontroller, a stack supply switch responsive to an operating state of the fuel cell system to provide an electrical path

between the fuel cell stack and the voltage responsive switching circuit and a battery supply switch responsive to a voltage across the fuel cell stack to provide an electrical path between the battery and the voltage responsive switching circuit" as recited, *inter alia*, by claim 12.

In rejecting claims 7, 11, 12, 29, and presumably 25, 30 and 33 (which are not explicitly addressed), the Examiner admits that Fuglevand does not teach a second switch, and also does not teach that the battery is uncoupled from the power supply when the voltage across the fuel cell stack is above a threshold. The Examiner concludes however, that the invention as a whole would have been obvious to one of ordinary skill in the art at the time of the invention, because Fuglevand would provide the artisan with sufficient guidance to ascertain the presence of the claimed features.

For example, in rejecting claims 7, 11, 12 and 29 the Examiner contends that the fact that the fuel cell stack is coupled to provide power to the control system after start-up fairly suggests including a second switch for simultaneously disconnecting the battery from providing power to the control system, in order to conserve battery power and allow for full charging of the battery. Office Action, page 4. In respect to claim 29, the Examiner goes on to suggest that it would also have been obvious to recouple the battery as the voltage of the fuel cell decreases below a threshold level during a shutdown state, in order to provide a relatively constant power supply to the control system. Office Action, pages 4-5.

Applicant respectfully disagrees. There is no motivation in the art for the proposed modification, *i.e.*, adding a second switch, where one switch is responsive to operating mode and the other switch is responsive to voltage. In fact, the Examiner's own contentions with respect to claims 7, 11, 12 and 29 belie this suggestion. In rejecting claims 7, 11, 12 and 29, the Examiner asserted that one of ordinary skill in the art would have provided a second switch to simultaneously disconnect the battery when coupling the fuel cell stack at the end of the startup period. This purported "second switch" would necessarily be responsive to the operating mode in order to operate simultaneously with the first switch, which Fuglevand teaches is responsive to operating mode (*i.e.*, start-up, not start-up). Thus, there is no motivation in the art for modifying the teachings of Fuglevand to employ a second switch. Likewise, there is no motivation in the art to modify Fuglevand to employ voltage responsive switches for coupling power to a control

system, let alone to employ both voltage responsive and operating mode responsive switches to provide power to a control system. Nor is there motivation in the art to modify the teachings of Fuglevand to use multiple voltage thresholds in selectively coupling power sources to a control system.

Claim 7 is dependent from claim 5 and further recites "a second power supply switch responsive to an operating state of the fuel cell system." Claim 25 is dependent on claim 23 and further recites "wherein the first time corresponds to a time when the fuel cell system is in a first operating state and a voltage across the fuel cell stack is above a first threshold voltage, and the second time corresponds to a time when the fuel cell system is in the first operating state and the voltage across the fuel cell stack is below a second threshold voltage." Claim 29 recites, *inter alia*, "setting the state of the battery supply switch to couple power from the battery to the on-board power supply if the voltage across the fuel cell stack falls below a lower fuel cell stack threshold voltage; and changing the state of the battery supply switch to couple the battery to the on-board power supply when entering a stopping operational state of the fuel cell system from the running operational state." Claim 30 is dependent from claim 29 and further recites "wherein changing a state of the stack supply switch includes coupling a signal from the controller to a switching input terminal of the stack supply switch." Claim 33 is also dependent from claim 29 and further recites "determining that the voltage across the fuel cell stack exceeds a third threshold voltage before entering a running state."

As explained above, there is no motivation in the art to modify the teachings of Fuglevand so as to read on the limitations of these claims.

<u>Conclusion</u>

Applicant thanks the Examiner for indicating the allowable subject matter of claims 13, 15-16, 18, 20, 23 and 31-32. Overall, the cited references do not singly, or in any motivated combination, teach or suggest the claimed features of the embodiments recited in independent claims 4-5, 12-14, 17, 20, 23 and 29, thus such claims are allowable. Because the remaining claims depend from the allowable independent claims, and also because they include additional limitations, such claims are likewise allowable. If the undersigned attorney has

overlooked a relevant teaching in any of the references, the Examiner is requested to point out specifically where such teaching may be found.

In light of the above amendments and remarks, Applicant respectfully submits that all pending claims are allowable. Applicant, therefore, respectfully requests that the Examiner reconsider this application and timely allow all pending claims. Examiner Crepeau is encouraged to contact Mr. Abramonte by telephone to discuss the above and any other distinctions between the claims and the applied references, if desired. If the Examiner notes any informalities in the claims, he is encouraged to contact Mr. Abramonte by telephone to expediently correct such informalities.

Respectfully submitted,

Seed Intellectual Property Law Group PLLC

Frank Abramonte
Registration No. 38,066

FA:jjf

Enclosure:
Postcard

701 Fifth Avenue, Suite 6300
Seattle, Washington 98104-7092
(206) 622-4900
Fax: (206) 682-6031

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